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A PARASITE UPON CARNATION RUST.

FREDERICK H. BLODGETT.



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*Connected with Fertilizer Control.

†Connected with Second Judicial Department Branch Station.

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SUMMARY.

The growers of carnations in America have been troubled since 1891 with a disease known as rust, *Uromyces caryophyllinus* (S.) Schroet. No marked success has followed the numerous attempts to check its development. Recently a natural check was noticed infesting the pustules of rust; this was the fungus, *Darluca filum* (Biv.) Cast. Possibly some benefit may be derived from artificially introducing this fungus into carnation houses, but it is not sufficiently abundant to be of great assistance in natural conditions.

INTRODUCTION.

The carnation industry employs many men and a large amount of capital and tends to concentrate about the large cities. Many varieties are grown, some healthy and robust, others diseased and sickly when similarly treated. One of the most common diseases is the rust, which manifests itself by producing blisters upon the leaves and stems from which a fine orange-brown powder escapes. The powder is formed of the spores of the fungus *Uromyces caryophyllinus* (S.) Schroet. There is no satisfactory method of controlling the rust when once introduced.

On many rusts there is present in the pustules a fungus which attacks the rust plant and lives upon it as the rust lives upon the host. This fungus, *Darluca filum* (Biv.) Cast., has been recently observed for the first time upon the carnation rust. In a greenhouse at Flatbush, Long Island, it has been found on the variety Gen. Maceo ; and in each of three different greenhouses at Geneva on several different varieties. While not naturally very effective as a check, by the use of artificial cultures or inoculations some benefit may be derived from its presence.

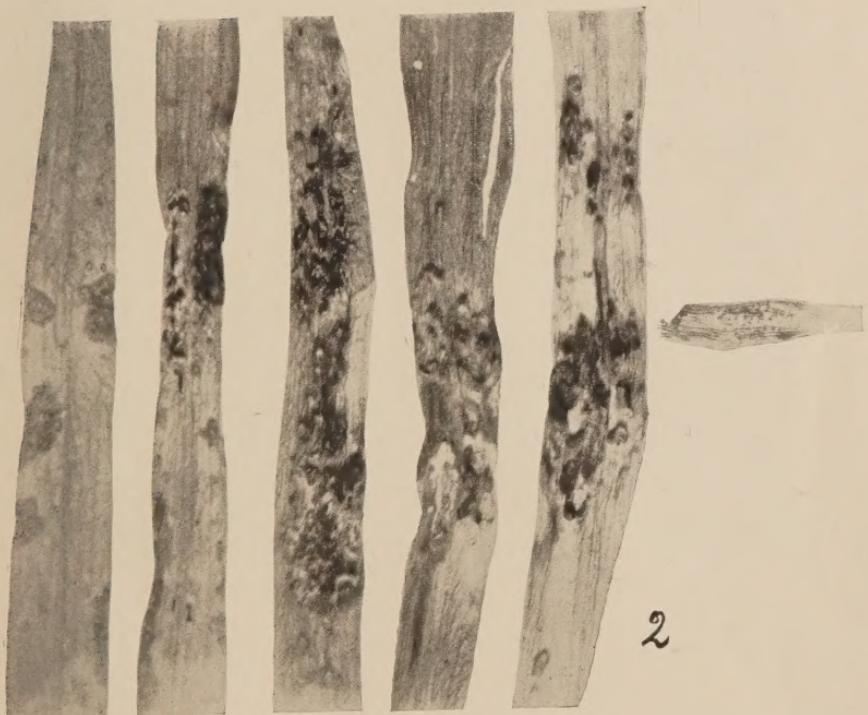
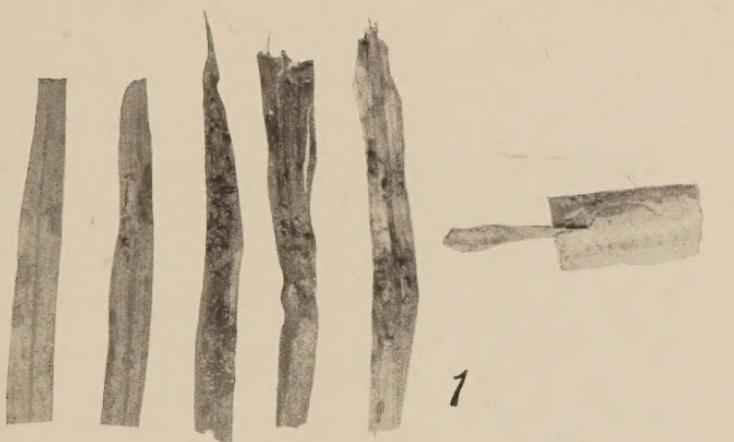


PLATE I.

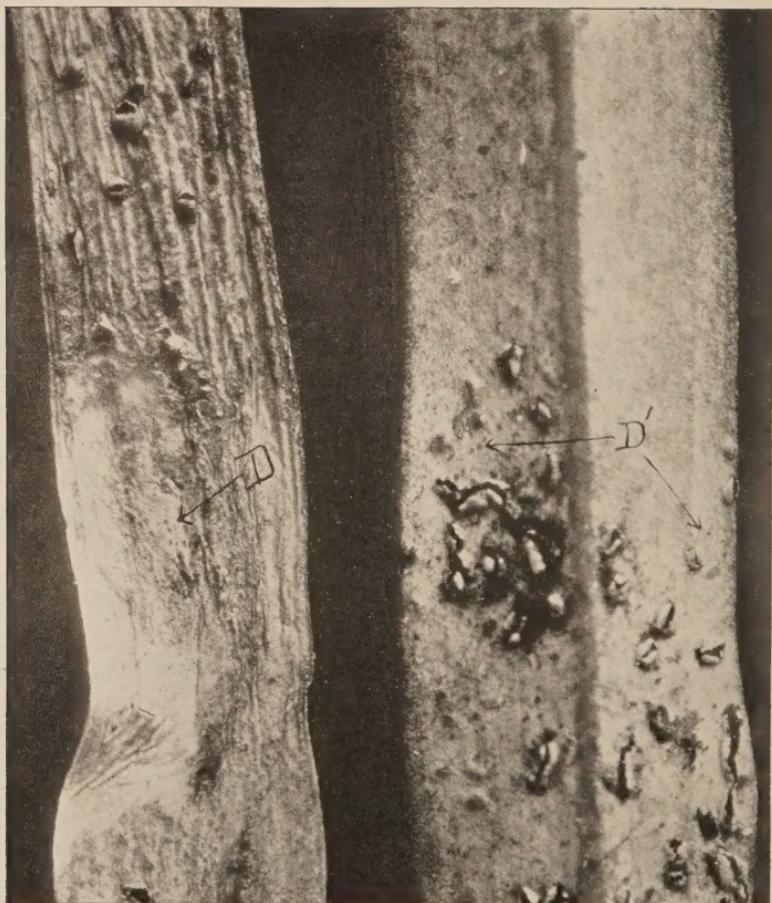


PLATE II.

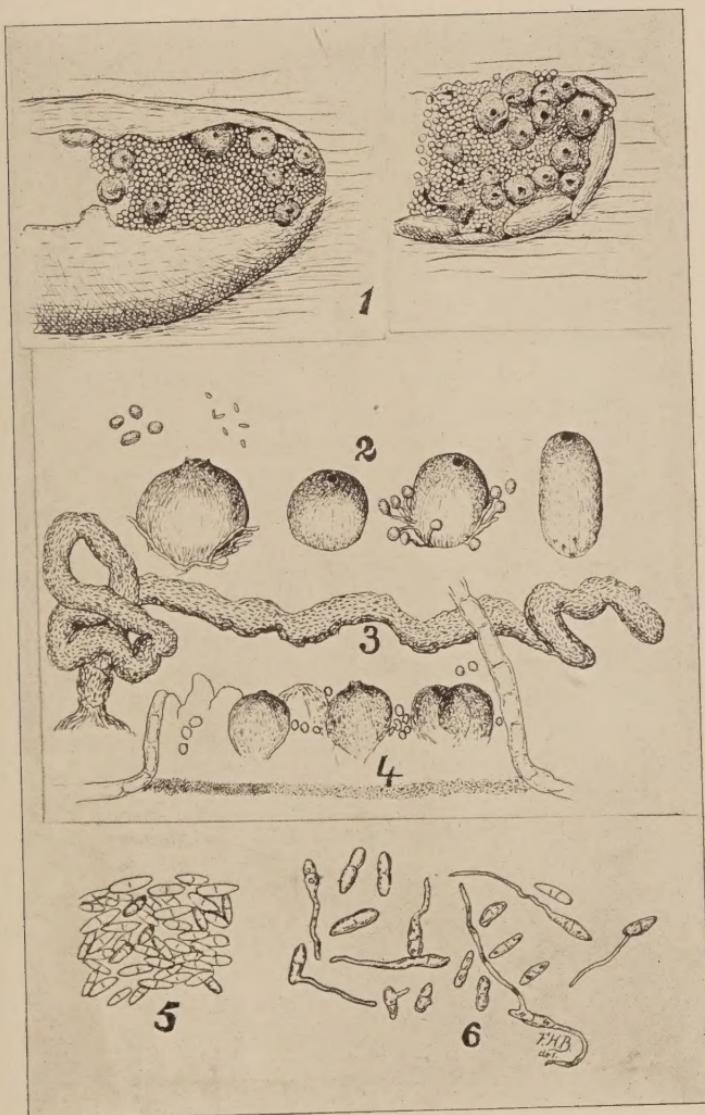


PLATE III.

EXPLANATION OF PLATES.

PLATE I.—1. Darluca infested carnation leaves. Natural size.
2. The same leaves enlarged three times. Purple spot at left (two leaves), dark spots in center and speck form at right. Photographed with yellow color screen, by author.

PLATE II.—Two Darluca infested leaves, enlarged six times, showing Darluca spots. The Darluca pycnidia are the black specks scattered among the rust pustules, as at D and D'. From photograph by the author.

PLATE III.—1. Two pustules of rust (*Uromyces caryophyllinus*) showing pycnidia of Darluca filum imbedded among the uredospores. 2. Isolated pycnidia of Darluca showing adherent filaments of *Uromyces*; showing also relative size of spores of Darluca and *Uromyces* and the variation in shape of Darluca pycnidia. 3. Gelatinous thread of Darluca spores. 4. Cross-section of a Darluca infested *Uromyces* pustule. 5. Darluca spores from gelatinous thread shown in Fig. 3. 6. Darluca spores germinating. All figures on this plate drawn with the aid of the camera lucida.

THE RUST.

Carnation rust is distinguished from other rust-colored troubles of the leaves by the presence of brown spores, which are liberated by the bursting of the "blister" in which they are formed. Each spore is normally capable of germinating and developing into a fresh spot of rust. Moisture and warmth are necessary to the best development of this fungus, hence warm, moist houses are more seriously infested than cool, dry ones growing the same varieties. Different varieties of carnations are subject to the rust in degrees varying with the variety. There seems to be some relation between the presence of "bloom" upon the leaves and immunity to the rust, as those varieties which have the most bloom are among those which rust but little. The rust usually does little real injury to the plant but in severe cases it may seriously check the natural growth of the host.

Once infested the plant continues to be rusted until destroyed. The hyphae of the fungus penetrate the leaf- and stem-tissue and produce here and there the pustules of spores, which are the visible evidence of the rust-plant. Cuttings taken from a rusted parent produce rusted plants¹, indicating the presence of the fungus hyphae in the actively growing portions of the plant. When the rust spores germinate they gain access to the interior of the leaf either through a stomate or some weak or broken spot in the leaf. From such a point as center the disease spreads through the cells of the host, securing the needed nourishment from these cells. It is now safe from any external treatment; any checks to its further development must be able to reach it within the tissues of the host and yet do no material injury to that host. Such a check is the fungus *Darluca filum*.

¹ Statement made by carnation growers of experience.

THE PARASITE.

(*Darluca filum* (Biv.) Cast.).

This fungus is related to the Septorias and Phomas familiar to florists through the diseases they produce. In some way this fungus has become adapted to living upon the tissues of other fungi instead of deriving its nourishment solely from the host plant.

The presence of *Darluca* is best determined with the microscope. But in cases where the rust is badly infested, the dwarfed and evidently crippled development of the rust pustules indicates that something is wrong. At times there are dead areas, in which are scattered a number of very fine black specks; these are the pycnidia of the *Darluca*. In other cases the infested area is nearly black, and the pycnidia are abundant. A third type of infestation is visible only with the aid of the microscope; in this the pycnidia are scattered among the spores in the infested pustules, which otherwise appear normal. In any case the presence of the *Darluca*, as of the rust, is shown externally only when it reaches maturity and produces spores.

The spores of *Darluca* are two-celled and colorless. They are developed within pycnidia or flask-shaped fruit-bodies, which may be nearly spherical, or much elongated. When a ripe pycnidium is moistened, the spores are expelled in a thick rope, which holds together by the gelatinous covering of the cell walls of the spores.

The pycnidia are formed from a cluster of interwoven vertical branches of hyphae. As the mass thus begun develops, a cavity is formed at the center, which enlarges until only a thin membrane is left as the pycnidial wall. From the interior of this membrane short branches have been produced at the ends of which spores are formed. When ripe the spores drop from their stalks, and others are formed in their places.²

² Sapin-Trouffy in *Le Botaniste*, 5: 51.

The spores germinate readily in water and produce germ tubes from either one or both cells, from any point of the cell wall. The hyphæ or germ tubes probably gain access to the interior of the rusted carnation leaf through a stomate. Once within and adjacent to the rust hyphæ, the parasitism begins and the two plants become closely interwoven. The growth of *Darluca* is most abundant close to the pustules of the rust. The leaf tissue beneath the infested spot seems filled with the hyphæ of the two fungi. Often a dark layer is developed at the original surface of the leaf, above which rise the spores and the pycnidia of the two fungi. The dark color may not be confined to a mere layer or band, but may extend to the whole of the dense mass of hyphæ, almost totally obscuring the structure of the carnation leaf.

The pycnidia are imbedded for two-thirds of their height among the spores of the rust, showing only the dark upper third when seen from above. The surface is smooth and rather shiny, and is marked with a fine irregular network of cells. At maturity an opening is formed at the apex through which the spores exude when wet. In the specimen figured (Plate III, fig. 3) a thousand spores were visible, and more were constantly issuing from the pycnidium at the left.

The same fungus infests the rust of the asparagus; and it may be that, either by growing garden asparagus in the houses or by spraying the carnations with water in which *Darluca* infested asparagus has been broken, a sufficient abundance of *Darluca* may be obtained to check the ravages of the rust.

At the present writing it is not known to what extent rust may be checked by the *Darluca*. It can not be expected to eradicate rust from a greenhouse, but its influence is good and it is believed to be worth the florist's while to encourage its growth.

